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Ethnobotanical survey of insecticidal plants in El Chellal (M'Sila) region and repellent activity of powder for some species

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Abstract:

The aim of this study is proposing alternatives to chemical insecticides harmful to health and the environment, this Ethnobotanical study inventories the plants with repellent or insecticidal properties used by the population of the El-Chellal regionand evaluate the repellent effect of some species: *Syzygium aromaticum* L., *Laurus nobilis* L., *Rosmarinus officinalis* L.,and *Ruta chalepensis* L. on the stored grain insect *Tribolium castaneum* Herbst. (Coleoptera, Tenebrionidae)in laboratory conditions.An Ethnobotanical investigation was carried out throughout the period from February to March 2026. A cumulative total of 244 respondents were surveyed regarding their awareness and utilization of indigenous flora across three villages in the El-Chellal area. The powders from four botanical sources were procured via an electric grinder and combined with durum wheat semolina; three dosages of 0.5g, 1g, and 1.5g were formulated and evaluated on red flour beetle.The survey revealed the utilization of 41 plant species of 23 families with Lamiaceae family dominating. The aerial parts are the most exploited resource with 67.18% of the uses. Moreover, the preparation methods are mostly controlled by the raw condition of the plant which shows the largest percentage with 39.88%. In the repellency test, it was found that the repellency rates of the powders were different according to the plant and the concentration of the powder. Powders of *Syzygium aromaticum*

L., *Ruta chalepensis* L. and *Laurus nobilis* L. were more repellent for *Tribolium castaneum* (100%, 87.78% and 76.83%), compared to powder of *Rosmarinus officinalis* L. (10%).

Keywords: Ethnobotanical, insecticidal plants, *Syzygium aromaticum* L., *Ruta chalepensis* L., *Laurus nobilis* L., *Rosmarinus officinalis* L., *Tribolium castaneum* Herbst., the repellent effect, powder.

1. Introduction

Stored-product insects are among the most damaging pests of cereals and pulses, causing both direct and indirect losses throughout grain processing and storage **(Chitra & Subramanian, 2016; Demis &Yenewa, 2022)**. Most of the species of economic importance belong to the orders Coleoptera, Lepidoptera and Psocoptera**(Demis &Yenewa, 2022)**, and beetles and weevils can destroy an entire stock within a short time if no protective measure is applied **(Tamgno& Ngamo, 2013)**.

For decades, grain protection has relied on synthetic pesticides. However, their adverse effects on human health and the environment, as documented for DDT and methyl bromide, together with the emergence of resistance, for instance to malathion, have prompted the search for safer control measures **(Hamel et al., 2020)**. Plants are a promising alternative: about 2,500 species from 235 families are reported to be effective against pests **(Ngegba et al., 2022)**. They produce bioactive compounds and defensive volatiles that repel herbivorous insects directly or attract their natural enemies **(Tamiru & Khan, 2017)**. They are also biodegradable and ecologically safe for treating stored products **(Elumalai et al., 2016)**.

Algeria holds a rich botanical heritage with strong potential for this purpose. Ethnobotanical surveys have documented the traditional use of numerous insecticidal plants, with Asteraceae, Lamiaceae and Apiaceae well represented **(Boudemagh et al., 2025; Bourenane et al., 2025)**. For example, 88 botanical pesticide species were inventoried in the Blidian Atlas, mostly used against stored-product insects **(Bourenane et al., 2025)**. Laboratory bioassays have confirmed the efficacy of several of these species. Powders of *Nerium oleander* and *Artemisia campestris* caused complete mortality of *Tribolium castaneum* adults **(Zohra et al., 2024)**, and powders of *Atractylisgummifera*, *Daphne gnidium* and *Thapsiagarganica* protected stored wheat against *Sitophilus granarius***(Chelef et al., 2020)**. Plant extracts can also

act through repellency and neurotoxicity, including inhibition of acetylcholinesterase **(Acheuk et al., 2020)**. Dry powders are the simplest and most accessible post-harvest option, since they require no sophisticated extraction and can be mixed directly with grain **(Peña-Flores et al., 2025)**.

Despite this body of work, knowledge of local insecticidal plants and of their repellent efficacy remains fragmentary for many regions, including El-Chellal (M'Sila), where no ethnobotanical data have been reported to our knowledge. Documenting this traditional knowledge and testing it experimentally is essential to validate local practices and to identify candidates for integrated pest management.

The present study therefore aimed (i) to inventory the plants with repellent or insecticidal properties used by the inhabitants of the El-Chellal region, and (ii) to evaluate the repellent effect of powders of *Syzygium aromaticum* L., *Laurus nobilis* L., *Rosmarinus officinalis* L. and *Ruta chalepensis* L. against the red flour beetle *Tribolium castaneum* Herbst.

2. Materials and Methods

Ethnobotanical survey

Study area

The study was conducted in El Chellal is a municipality and the administrative center of a daïra in the wilaya of M'Sila, Algeria **(Figure 01)**. The region is part of the Algerian Highlands, characterized by a distinctive topography that connects the Tell Mountains and the Saharan Atlas Mountains, near the Hodna region. Located at approximately 35.51° N latitude and 4.23° E longitude, this town has a semi-arid climate, with hot, dry summers and moderate annual average temperatures.

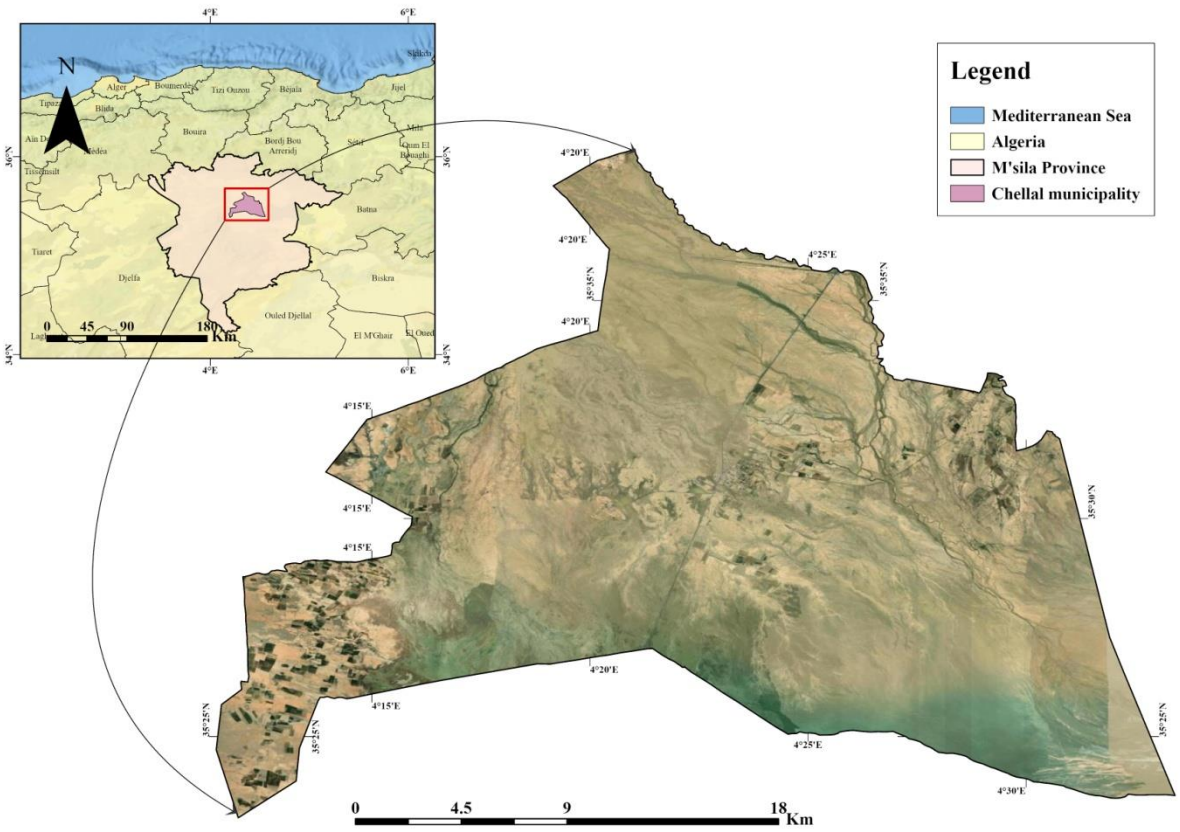


Figure 01: Map of the region considered in this stud

Survey and Data Collection

Using 244 questionnaire forms, an ethnobotanical field survey was conducted during February and March 2026 among people who come into contact with plants (farmers, city dwellers, and herbalists) throughout the El-Chellal-M'sila region.

Each survey questionnaire form contains the following information: personal information (age, gender and education level) and information about the insecticidal plants used (plant name, part used, purpose of use, method of use).

Repellent activity of powders

Animal Material

The mass breeding of *Tribolium castaneum* is carried out in a plastic container containing 5 kg of durum wheat semolina. This is done under laboratory conditions at a temperature of 20-25°C and at a relative humidity between 65 and 70%.

Plant Material

In our study, the plant material consists of*Syzygiumaromaticum*L.,*Laurus nobilis* L.and*Rosmarinus officinalis*L.and *Ruta chalepensis* L.was obtained from herbalists of the wilaya of M'sila.

The four dry plants are ground separately using an electric grinder until they are reduced to a powder. The powder from each plant was kept in glass jars away from light until it was used.

Repellency test

The repellent effect of the powder of each plant on the adults of the *Tribolium castaneum* Herbest. was evaluated using the preferential zone method on filter paper described by **Mc Donald *et al*., (1970)** with some modification.

Repellency assay was carried out in glass Petri dishes diameter 09 cm (63,62 cm^2). The Whatman filter paper 09 cmwas cut into two equal halves and 0.5g, 1g and 1.5g of each powder plants was mixed with 2g ofdurum wheat semolinaapplied to filter paper half as uniform. The other half of filter paper was treated with 2g semolina only. Twenty insects were released at the centre of the filter paper disc and then Petri dishes were covered. Three replicates were set for each dose of powders.

Number of insects on both treated and untreated halves was recorded after 2 h of the start of the experiment:

$$PR\ (\%) = [(Nc - Nt) / (Nc + Nt)] \times 100$$

Nc is the number of beetles on the control half, and **Nt**is the number on the treated half.

Table 01: Repellency percentage according to the classification by **McDonald et al., (1970).**

Class	**PR proportion (%)**	**Description**
O	PR < 0.01	Not repellant
I	0.1 < PR ≤ 20.0	Fair repellant
II	20.1 ≤ PR ≤ 40	Moderate repellant
III	40.1 ≤ PR ≤ 60	Good repellant
IV	60.1 ≤ PR ≤ 80	Very repellant

V	80.1≤ PR ≤ 100	Perfect repellant

Data analysis

The data recorded on the survey forms were then entered and analyzed using Microsoft Excel 2007. The Relative Citation Frequency (RCF) was calculated using Equation:

RCF = Citation frequency per plant / Total number of references × 100

3. Results

Ethnobotanical survey

A total of two hundred forty-four (244) informants were interviewed, including 72.13% in Khatouti, 19.67% in Sed eldjir, and 8.20% in Chellal **(Figure 02).** The informants are divided by gender as follows: 122 men (53 of whom use insecticidal plants and 69 of whom do not) and 122 women (72 of whom use insecticidal plants and 50 of whom do not) **(Figure 03)**, and their ages range from 20 to 70 **(Figure 04)**. The majority of respondents who use insecticidal plants have a university degree (48.21%) **(Figure 05).**

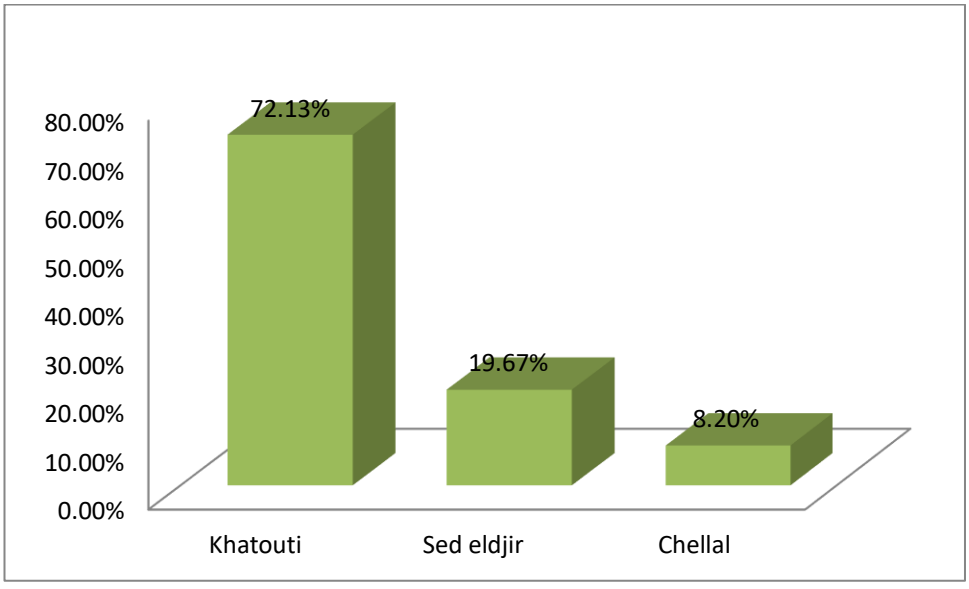


Figure 02: Distribution ofinformants from the communities of El-chellal.

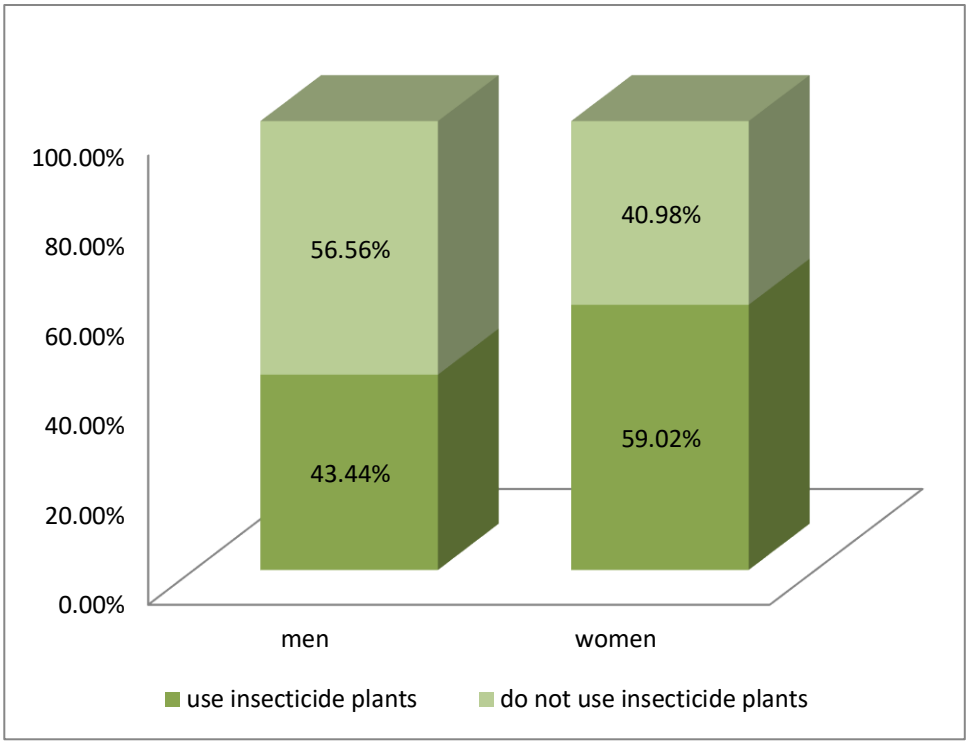


Figure 03: Distribution of informant's sex.

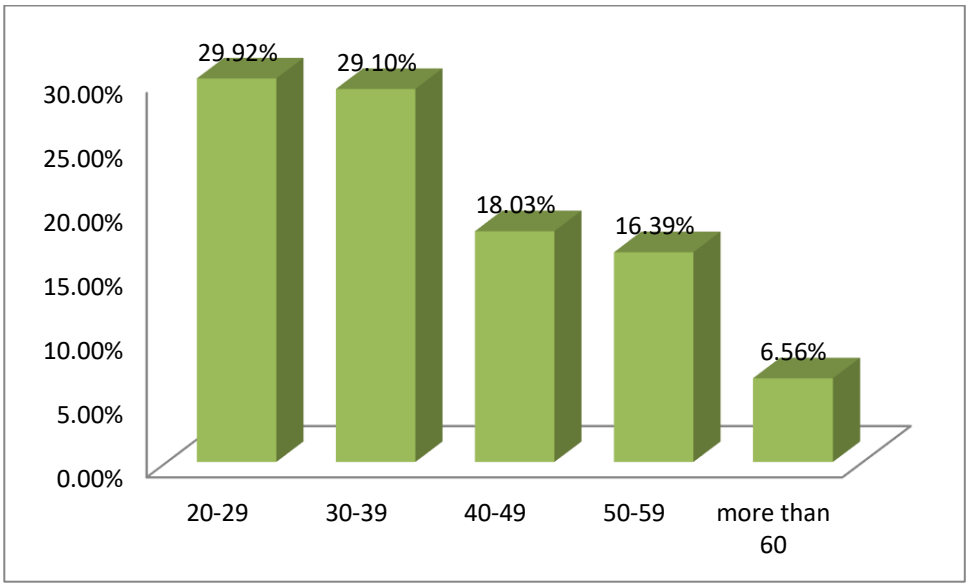


Figure 04: Distribution of informant's age

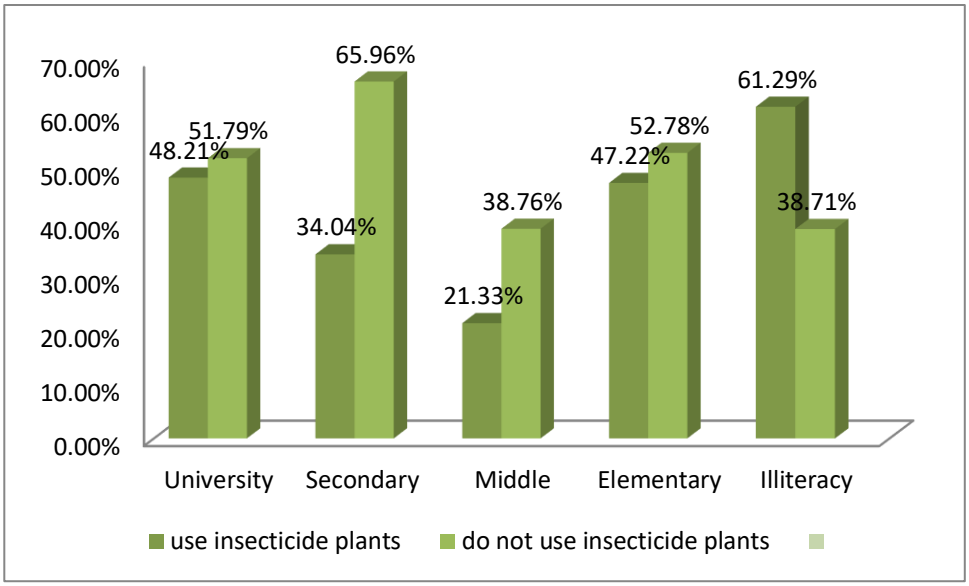


Figure 05: Distribution of respondents according to the level of study

The results show that 41 different plant species from 23 different families **(Table 02)**were used in the El-Chellal region to control insects' pests.The most important family is the Lamiaceae, represented by 8 species, the Cucurbitaceae, Myrtaceae and Solanaceae families with three species, the Asteraceae, Rutaceae, Lauraceae, and Apiaceae families with two species each, and the rest of the families are represented by a single species.Regarding the species most used by the surveyed population are respectively: Green mint (*Mentha spicta* L.), White wormwood (*Artemisia herba alba* Asso.), Black pepper (*Piper nigrum* L.), Common myrtle (*Myrtus comminus* M.), Chili pepper (*Capsicum annuum* L.), Clove (*Syzygium aromaticum* L.), Lavender (*Lavandula officinalis* L.), Oregano (*Thymus* sp.), Oleander (*Nerium oleander* L.), Rosemary (*Rosmarinus officinalis* L.), Rue (*Ruta chalepensis* L.), Lemon (*Citrus limonum* Risso.), and Harmel (*Peganum harmala* L.).

The inhabitants of El-Chellal use plants with insecticidal properties to combat a variety of insects, according to the results shown in **figure 06**. Mosquitoes account for 43.87% of all insects attacked, followed by stored grain insects (29.45%), flies (28.83%), ants (19.33%), and textile moths (15.34%).Of the 244 respondents, 85.89% employ insecticidal plants to repel harmful insects, while 15.64% use them to kill them(**Figure 07).**

Table 02: The insecticidal plants used in the El-Chellal region

Plants species	**Family Name**	**Localy Name**	**Used parties**	**Methods used**	**Targetedinsects**	**The purpose of its use**
Mentha spicata L.	Lamiacées	النعناع Nànaa	Aerial part Roots	Raw plant Aqueous solution Powder Burn the leaves	Mosquitoes Flies Ants Stored grain insects Moths	Expulsion Murder
Mentha pulegium L.	Lamiacées	فليو Flyou	Aerial part	Powder	Mosquitoes Flies Stored grain insects	Expulsion
Salvia Officinalis L.	Lamiacées	ميرمية Mirameya	Aerial part	Aqueous solution	Mosquitoes	Expulsion
Lavandula officinalis L.	Lamiacées	خزامى Khzama	Aerial part	Raw plant Aqueous solution Powder Burn the leaves	Mosquitoes Flies Ants Stored grain insects Moths	Expulsion Murder
*Ajuga iva*L.	Lamiacées	الشندقورة Chandgora	Aerial part	Raw plant Powder	Mosquitoes	Expulsion
Rosmarinus officinalis L.	Lamiacées	إكليل Iklil	Aerial part Roots	Raw plant Aqueous solution Burn the leaves	Mosquitoes Flies Ants Stored grain insects Moths	Expulsion Murder
Thymus vulgaris L.	Lamiacées	الزعتر Zaatar	Aerial part	Raw plant Powder Burn the leaves	Mosquitoes Flies Stored grain insects Moths	Expulsion Murder
Melissa officinalis	Lamiacées	المليسة Melissaa	Aerial part	Raw plant	Mosquitoes	Expulsion
Cucurbita pepo	Cucurbitacées	كابوية kaboya	Aerial part	Raw plant	Flies	Expulsion
Citrullus	Cucurbitacées	الحضل	Fruits	Aqueous solution	Mosquitoes Flies	Expulsion

colocynthis		Handhal			Ants	
Cucumis sativus L.	Cucurbitacées	الخيار K'yar	Aerial part Fruits	Raw plant	Stored grain insects	Expulsion
Capsicum annum L.	Solanacées	الفلفل الحار Felfelhar	Aerial part Seeds Fruits	Raw plantPowder Burn the leaves	Mosquitoes Flies Ants Stored grain insects	Expulsion Murder
Cestrumnocturnum L.	Solanacées	مسك الليل Meskelil	Aerial part	Raw plant	Mosquitoes Flies	Expulsion
Nicotiana tabacum L.	Solanacées	التبغ Tebgh	Aerial part	Raw plant Aqueous solution Burn the leaves	Mosquitoes Flies Stored grain insects Moths	Expulsion Murder
Artemisia Herba alba Asso.	Astéracées	الشيح Chih	Aerial part	Raw plant Aqueous solution Burn the leaves Powder Other method	Mosquitoes Flies Ants Stored grain insects Moths	Expulsion Murder
Chrysanthemum sp.	Astéracées	أقحوان Okehowan	Aerial part	Aqueous solution Burn the leaves Powder	Mosquitoes Flies Stored grain insects Moths	Expulsion Murder
Myrtus comminus L.	Myrtacées	ريحان Raihan	Aerial part Seeds	Raw plant Aqueous solution Burn the leaves Powder Other method	Mosquitoes Flies Ants Stored grain insects Moths	Expulsion
Syzygium aromaticum L.	Myrtacées	قرنفل kronfel	Aerial part Seeds Fruits	Raw plant Aqueous solution Burn the leaves Powder	Mosquitoes Flies Stored grain insects Moths	Expulsion
Eucalyptus globulus L.	Myrtacées	الكاليتوس Kalitousse	Aerial part	Raw plant Aqueous solution Burn the leaves Powder	Mosquitoes Flies	Expulsion

				Other method		
Ruta chalepensis L.	Rutacées	الفيجل Fidjel	Aerial part	Raw plant Aqueous solution Burn the leaves Powder	Mosquitoes Flies Ants	Expulsion
Citrus limonum Risso.	Rutacées	الليمون Limoune	Aerial part Fruits	Raw plant Aqueous solution Burn the leaves Other method	Mosquitoes Flies Ants Moths	Expulsion Murder
Cinnamomum verum	Lauracées	القرفة Karfa	Bark	Raw plant Aqueous solution Powder Other method	Flies Ants Stored grain insects	Expulsion
Laurus nobilis L.	Lauracées	الرند Rand	Aerial part Roots	Raw plant Burn the leaves Other method	Flies Ants Stored grain insects	Expulsion
Allium cepa L.	Liliacées	بصل Bassal	Bulb	Raw plant	Flies	Expulsion
Allium sativum L.	Liliacées	الثوم Thoum	Aerial Part Bulb	Raw plant	Mosquitoes Flies Stored grain insects	Expulsion
Coriandrum sativum L.	Apiécées	الكزبرة koussbre	Aerial Part	Raw plant	Flies -Ants	Expulsion
*Ferula assafoetidas*L.	Apiécées	الحلتيت Heltit	Resin	Raw plant Powder	Mosquitoes Flies Ants	Expulsion
*Piper nigrum*L.	Piperacées	الفلفلالأسود Felfel aswad	Seeds	Raw plant Powder Burn the leaves Other method	Stored grain insects	Expulsion Murder
Olea sp	Oléacées	زيتون Zitoun	Aerial Part	Burn the leaves	Mosquitoes Flies	-Expulsion

Nigella sativa L.	Renonculacées	سينوج Sinoudj	Seeds	Powder Burn the leaves Other method	Mosquitoes Flies Stored grain insects	Expulsion Murder
*Peganum harmala*L.	Zygophyllacées	الحرمل Harmel	Aerial part	Raw plant Burn the leaves Other method	Mosquitoes Flies Stored grain insects Moths	Expulsion
Nerium oleander L.	Apocynacées	الدفلة Defla	Aerial part	Raw plant Aqueous solution Powder Burn the leaves Other method	Mosquitoes Flies Ants Stored grain insects Moths	Expulsion Murder
Juniperus phoenica L.	Cupressacées	العرعار Arar	Aerial part	Burn the leaves Other method	Mosquitoes Flies Ants Moths	Expulsion
Coffea sp.	Rubiacées	قهوة Kahwa	Seeds	Powder	Ants	Expulsion
Lawsonia inermis L.	Lythracées	الحنة Henna	Aerial part	Raw plantPowder Burn the leaves	Mosquitoes Ants Moths	Expulsion Murder
*Urtica urens*L.	Urticacées	الحريق Hourik	Aerial part	Raw plant	Mosquitoes	Expulsion
Cynodon dactylon	Poacées	النجم Njem	Aerial part	Burn the leaves	Mosquitoes Flies	Expulsion
*Borago officinalis*L.	Boraginaéces	لسان الثور Lesan ethour	Aerial part	Raw plant	Flies	Expulsion
Pélargonium graveolens	Géraniacées	عطرشة Aterchaya	Aerial part Roots	powder	Ants	Expulsion
Azadirachta indica L.	Meliacées	النيم Neem	Aerial part	Raw plant	Ants	Murder
Ziziphus spinachristi L.	Rhamnacées	السدر Sedra	Seeds	Aqueous solution	Moths	Murder

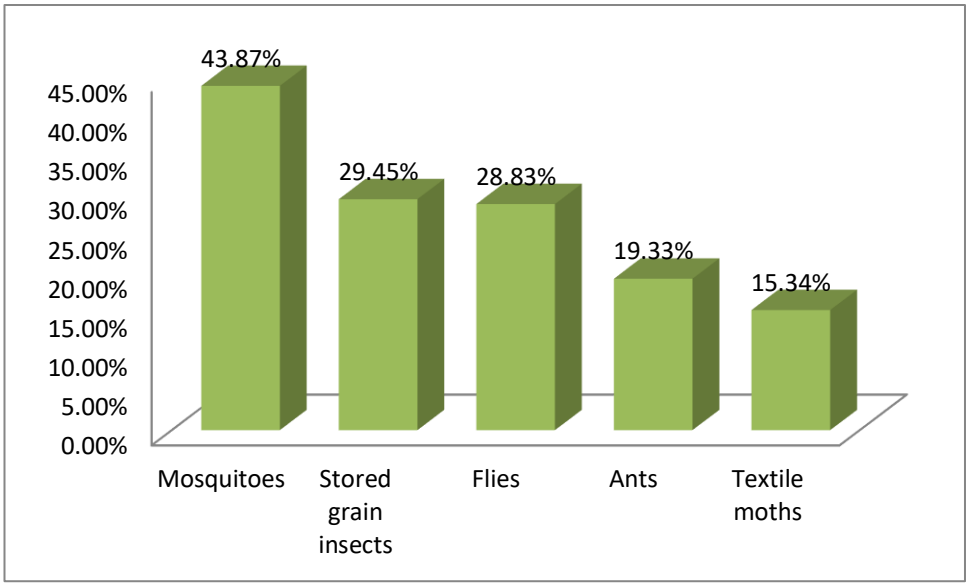


Figure 06: The insects targeted by insecticidal plants

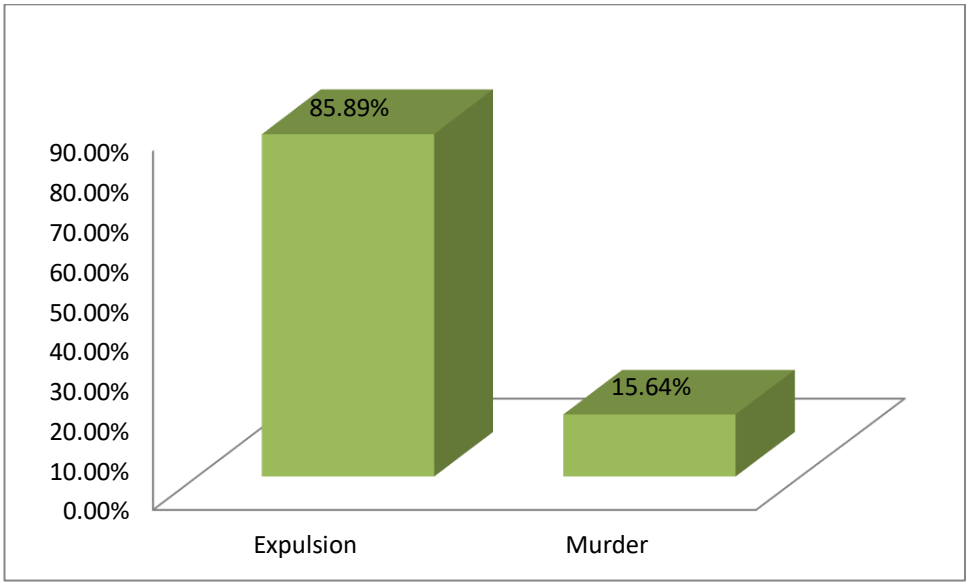


Figure 07: The purpose of using insecticidal plants

The parts of the plants that are most commonly used are the aerial (vegetative) part with a percentage of 80.48% mainly followed by the seeds with 17.07 %, the fruits with 12.19%,the roots with 9.70%, the bulb with 4.87% and lastly the bulb and the resin with 4.60%(**Figure 08).**The methods of using insecticidal plants by the inhabitants of the El-Chellal region vary depending on the type of plant used and the type of insect targeted. The most common methods, the use of raw plants represented the highest percentage (39.88%), followed by powder (29.14%), burning the leaves (19.02%), aqueous solution (14.42%), and other methods (10.43%) **(Figure 09)**.

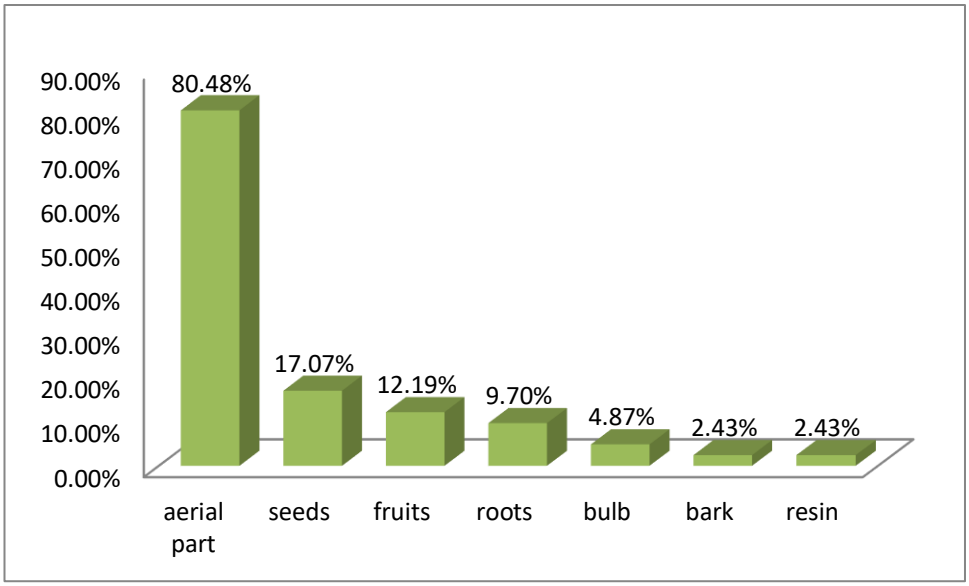


Figure 08: The part of the plants that is used

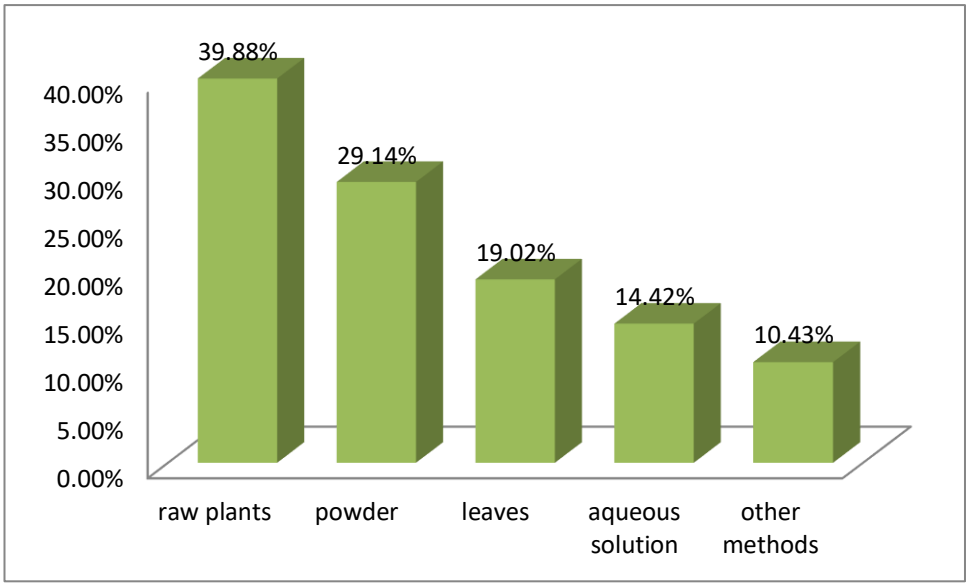


Figure 09: The different methods of using insecticidal plants

Repellent activity of powders

The results of the evaluation of therepellency effects of the powders from *Syzygium aromaticum* L.,*Ruta chalepensis* L., *Laurus nobilis* L. and *Rosmarinus officinalis* L.on adults of *Tribolium castaneum*Herbest. are shown in **Table 03** and **Figure 10**. The results also revealed a very effective repellent potential of *Syzygium aromaticum* L. powder against adults of *Tribolium castaneum* with all doses repelling at least 100% of the insects in less than 2 hour of exposure. The highest dose of *Ruta chalepensis* L., *Laurus nobilis* L. and *Rosmarinus officinalis* L.had a strong repellent effect of 87.78%, 76.83%, 16.65%respectively on adults of *T. castaneum*. At the

lowest dose repellency effect of powders from *Syzygium aromaticum* L., *Ruta chalepensis* L., *Laurus nobilis* L. and *Rosmarinus officinalis* L. were recorded to be 76.65%, 73.35% and 3.35%. This clearly shows that the percentage of repulsion increases depending to the plants species and the doses of powders, the most remarkable effect is recorded with the dose (1.5g).

Table 03: Repulsion percentage of powder from *Syzygium aromaticum*L., *Ruta chalepensis*L., *Laurusnobilis* L. *Rosmarinus officinalis*L.against*Triboliumcastaneum*Herbest.adults

Doses of Powder	0.5g	1g	1.5g	**Repulsion Mean %**	**Class**
*Syzygiumaromaticum*L.	%100	%100	%100	%100	V Perfect repellant
Ruta chalepensis L.	76.65%	93.35%	93.35%	87.78%	V Perfect repellant
Laurus nobilis L.	73.35%	73.35%	83,35%	76.83%	IV Very repellant
*Rosmarinus officinalis*L.	3.35%	10%	16.65%	10%	I Fair repellant

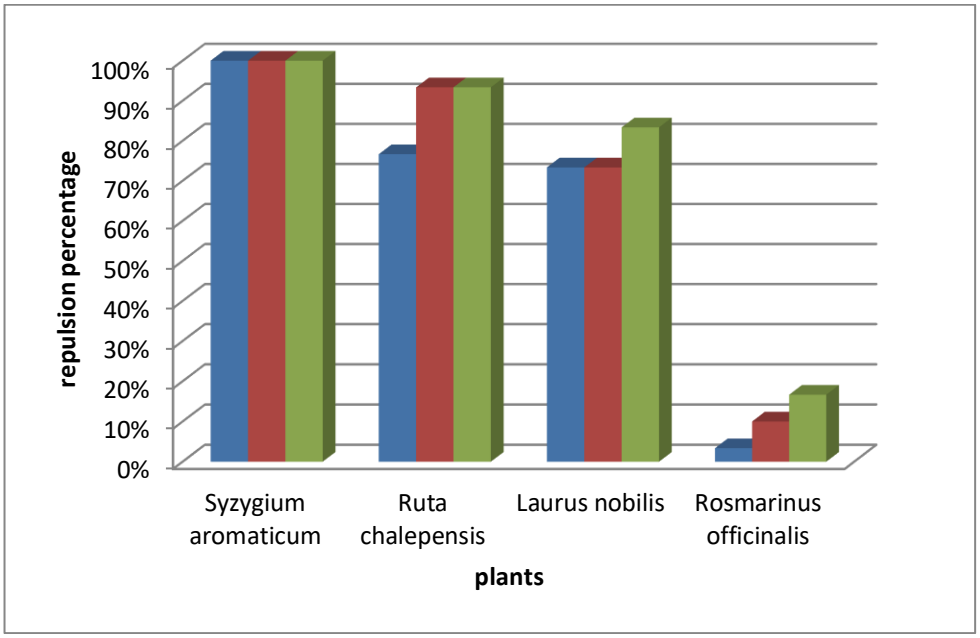


Figure 10: Repulsion percentage of powder from *Syzygium aromaticum* L., *Ruta chalepensis* L., *Laurus nobilis* L. and *Rosmarinus officinalis* L. on adults of *Tribolium castaneum*

4. Discussion

This study aimed to gather and document the knowledge of the El Chelal population regarding plants used as insecticides or repellents, with the goal of identifying potential candidates for the development of anti-insecticide products. The results reveal women predominance among the interviewed traditional healers, with 59.02% women compared to 43.44% male.These values are similar to the results obtained in other studies on the use of insecticidal plants by women **(Baana et *al*., 2018; Karunamoorthiet Hailu, 2014**), but contradicts the results obtained in Bénin, where it was reported that women represented the majority of practitioners in this field**(Dossou et *al*., 2025).**Data analysis reveals that plants from the Lamiaceae family are the most frequently cited for pest control, having been extensively researched for their insecticidal qualities**(Yeom et *al*., 2018;Abo El-Kasem Bosly, 2022; Yanget*al*., 2023; Ayala-Guerrero et *al*., 2026).** The plant most frequently mentioned in the study is the Green mint (*Mentha spicta* L.). Research conducted in Algeria has already highlighted the insecticidal properties of this plant,the essential oil extracted from Mentha spicata L. collected from Bir Ghebalou mountain, near Bouira, Algeria was tested for their bio-insecticide effect against two different insect pest species affecting stored cereals .The test results showed that the aerial part of Spearmint have a toxic effect on adults of Weevil (60% mortality) and Tribolium (70% mortality)**(Bendifallah et *al*., 2021),** Research by **Mejdoub et *al*. (2019)** validated that *Mentha spicata* possesses insecticidal properties targeting *Bactroceraoleae*, which causes olive rot.

Among the plant species listed in this survey, the most commonly used parts are the aerial parts (80.48%). This predominance of the use of aerial parts could be explained by the immediate availability of their active constituents, often in the form of volatile compounds. Indeed, the most frequently used insecticidal or repellent plants are generally those rich in essential oils.

In the present study, the best repellency test results against *T. castaneum* were obtained at a dose of 1.5g of *Syzygium aromaticum* L.and*Ruta chalepensis* L. powders. The powders of *Laurus nobilis* L. and *Rosmarinus officinalis* L. at the same dose presented lower repellency. Repellency actions of powder from some plant materials against insect pests of stored products have been tested by some researchers (**Achiri et Njweng, 2015**;**Suleiman et Sani, 2017;Pena-Flores et *al*., 2025; Nazir et *al*., 2025; Mahmoud et *al*., 2026)**

The superior performance of powder of *Syzygium aromaticum* L. observed in this study aligns closely with the findings of **Bandara et Senevirathne (2021),** Statistically significant contact repellent effects ($p < 0.05$) were observed across all tested concentrations (200, 400, and 600 mg) and exposure durations (1 to 24 hours) for the bud, stem, and leaf powders.Bud powder demonstrated the highest overall repellency, reaching93.33 % at 400 and 600 mg concentrations after 24 hours, and achieved over 50% repellency within just 2 hours of treatment.Stem powder recorded the second-highest repellent activity (81.67 %) at 600 mg after 24 hours, crossing the 50% threshold after 6 hours.Leaf powder consistently exhibited the weakest repellent effect among the tested parts. According to the evaluation classes, bud powder (Class IV) and stem powder (Class III) were categorized into the highest repellent tiers. The mean repellency of ants ranged from 98.6 to 99.4% when the application rate of clove powder was increased from 0.34 to 1 mg/cm2 at 3 hours **(Lekhnath et Cheng, 2013).Najem et *al*. (2019)** confirmed the potent insecticidal properties of *Ruta chalepensis* L. powder against *Tribolium castaneum* (Herbst.) adults. Their study revealed that adult mortality rates increase with both exposure duration and dosage, demonstrating significant efficacy even at a low dose of 0.5 g. notably, mortality reached 100% within 22 days at a 2 g dose, underscoring the strong potential of *Ruta chalepensis* L. powder as a bio-insecticide.Concerning the insecticidal and repellent properties of *Laurus nobilis* L., a laboratory study conducted in Oaxaca, Mexico, found that powder concentrations of 1%, 2%, and 3% yielded lower mortality and repellency rates against the insect *Sitophilus zeamais* (**Pena-Flores et *al*., 2025).**

The repulsive effects observed in this study may be attributed to various secondary metabolites present in the studied plant species, to the potential insecticide of essential oils, or to various extracts of those plants species, which have been demonstrated against several insect species causing damage to a variety of cultures.

Repellency tests results indicated that cloves essential oil possessed significant pest repellent activity to S. zeamais. Repellent action was highly dependent upon oil concentration and exposure time. Essential oil of cloves at 10% concentration showed highest repellent activity (98.75%) against S. zeamais at 24 h **(Aryal et *al*., 2023)**. **Alimi et *al*., (2023)** evaluated the adulticidal, ovicidal, larvicidal and repellent proprieties of clove essential oil, eugenol and ethanolic extract on *Hyalomma scupense*, in vitro. Eugenol, the primary phytoconstituent of clove oil, which accounts for 97.66% of the whole oil, had 99.22% acaricide activity and inhibited

egg hatching at a concentration of 10 mg/mL. Eugenol and clove essential oil showed potent adulticidal effect at high concentrations (10 mg/mL), achieving 100 and 93.76% mortality, respectively. The ethanolic extract exhibited moderate activity. At high concentration, the larvicidal activity of *S. aromaticum* oil, eugenol, and ethanolic extract were 100, 100, and 77.18%, respectively. In filter paper experiments, when tested at the concentration 5 mg/mL; eugenol showed the longest repellent effect up to 6 h. We also found that eugenol was the most active AChE inhibitor (IC50 = 0.178 mg/ mL).**Tampe et *al*., (2016)** evaluated the repellent effect of the essential oil of the rue (*Ruta chalepensis*)against the weevil *Aegorhinus superciliosus,* an important pest of fruit crops in Chile. Behavioral bioassays showed that the rue essential oil elicited a repellent effect against male andfemale *A. superciliosus* ($p \leq 0.05$) at a concentration of 1.92 x 107 ng/cm2. However, at a lower concentration ofthe oil (285.7 ng/cm2), only females were repelled ($p \leq 0.05$).The essential oil of*Ruta chalepensis*is endowedwith a very repulsive power belonging to class V, which is strongly due to its majority compound 2-undecanone. The dose 0.038 µl/mlgave a repellent power of 100% after 15 min. The tests also revealed a considerable insecticidal effect, which reached 100% after 48 hoursat a dose of 0.62 µl/ml **(Najem et *al*., 2020)**.**El Baghazaoui et *al*.,(2024)**assess the effectiveness of essential oils (EOs) derived from *Laurus nobilis* L. leaves originating from the Tanger (EOT) and Meknes (EOM) regions in combating *Callosobruchus maculatus* infection. Notably, the EOs exhibited significant repellent activity against *C. maculatus*, with repulsion percentages ranging from 51.11 to 90.00% in Tanger and 67.78 to 93.33% in Meknes. Mortality rates varied from 0 to 100% depending on the treatment. However, the mean concentrations showed mortality rates ranging from 29.44 to 65.56% for the EOT and from 21.11 to 67.78% for the EOM. Using a dual-choice olfactometer, the essential oil of *Laurus nobilis* L. exhibited a clear dose-dependent repellent activity against adult *E. ceratoniae*. Repellency ranged from 32.4% at the lowest concentration to 94.6% at 8.0% after one hour, with the highest concentration maintaining 79.4% repellency even after six hours**(Ben Salah et *al*., 2025).**The repellent effect of rosemary essential oil was evaluated against *T. castaneum* and *S. oryzae*. For *T. castaneum*, peak repellency occurred at doses of 62.87 and 31.44 µg/cm², with ANOVA revealing a significant effect of time (P = 0.0026), doses (P = 0.0129), and their interaction (P = 0.0112). Conversely, for *S. oryzae*, maximum repulsion was observed at 251.49 µg/cm², though exposure time, doses, and their interaction were not statistically significant (**Mahfuz et *al*., 2023).Pedroso et *al*., (2023)** tested the effects of *R. officinalis* essential oil on biomarkers of

oxidative damage in *Drosophila melanogaster*. Exposure to *R. officinalis* essential oil increased adultmortality and decreased geotaxis behavior in adult fruit flies .In addition, essential oil increased of larval mortality and impaired the developmental success in *D. melanogaster*. *R.officinalis* essential oil showed a significant repellent effect, with duration time of about 6h.

Plant species with repellent properties protect stored foods, such as cereals and legumes, as well as other valuable commodities from pest damage. By rendering these materials unpalatable or offensive, plants effectively deter pests from infesting them **(Ito et Anigboro, 2019)**.The effect of plant powders is mainly explained by causing the deathof the individual due to toxicity derived from direct physical contact, making breathingdifficult, and/or causing abrasion of the cuticle, leading to water loss and dehydrationand/or ingestion; in food deterrence by making the food unattractive and/or unpleasant,causing the death of the insect due to starvation; by decreasing the oviposition rate due to the reduction in the longevity and physical condition of adults to procreate; as well asthe presence of volatile compounds that repel individuals **(Boate et Otayor, 2020).**

5. Conclusion

This study explored local knowledge on repellent or insecticidal plants against harmful insects in El Chellal, identifying 41 species used. The aerial part is the most used part due to its richness in volatile compounds. The use of the raw plant is the most commonly used method. Based on **Mc. Donald's (1970)** classification, the findings indicate that all tested plants powders exhibit potential repellent properties on *Tribolium castaneum* Herbest. That the percentage of repulsion increases depending to the plants species and the doses of powders, the most remarkable effect is recorded with the dose (1.5g) and the species *Syzygium aromaticum* L. The results highlight the potential of these plants for the development of new products. However, further studies are necessary to deepen the understanding of the mechanisms of action of these plants and to validate their effectiveness through phytochemical analyzes and practical trials.

References

1. Abo El-Kasem Bosly H. (2022). Larvicidal and adulticidal activity of essential oils from plants of the Lamiaceae family against the West Nile virus vector, *Culex pipiens* (Diptera: Culicidae). *Saudi Journal of Biological Sciences,* 29 (103350), 10p.

2. Acheuk, F., Abdellaoui, K., Lakhdari, W., Chahbar, N., Belaid, M., Baouche, N., & Bouazouz, H. (2020). Potentials of the extracts of Algerian Saharan plant Cotula cinerea for the management of two insect pests, *Aphis fabae* and *Tribolium castaneum*. Tunisian Journal of Plant Protection, 15(2). https://doi.org/10.52543/tjpp.15.2.2

3. Achiri D. T. &Njweng M. A. (2015). Bioactivity of cypress leaf powder (*Cupressus macrocarpa*) on cowpea weevil (*Callosobruchus maculatus* Fabr. Coleoptera: Bruchidae) and maize weevil (*Sitophilus zeamais*Motschulsky, Coleoptera: Curculionidae) in stored maize grains in Cameroon. *International Journal of Interdisciplinary and Multidisciplinary Studies* (IJIMS), 2(4): 1-10

4. Alimi D., Hajri A., Jallouli S. &SebaiH. (2023). Toxicity, repellency, and anti-cholinesterase activities of bioactive molecules from clove buds *Syzygium aromaticum* L. as an ecological alternative in the search for control *Hyalommascupense*(Acari: Ixodidae)*Heliyon,* 9 (e1889): 1-11

5. Aryal S., Poudel A., Bajracharya A.S.R, Aryal L.N. & Kafle K.(2023). Toxicity evaluation of essential oil of clove (*Syzygium aromaticum*) bud against *Sitophilus zeamais*Motschulsky (Coleoptera: Curculionidae). *Journal of Nepal Agricultural Research Council,* 9:22-35.

6. Ayala-Guerrero L.M., Mondragon -Rojas F.J., Cabrera-Hidalgo A. D. J., Bivian-Hernandez M. l.A., Gomez-Patino M. B., Andrade-Hoyos P., Mendieta-Moctezuma A. & Ibarra-Torres P. (2026). Fumigant Toxicity of Essential Oils of the Lamiaceae Family Against *Spodoptera frugiperda*Larvae.*Insects*, 17, 162

7. Baana K., Angwech H. & Malinga G.M., (2018). Ethnobotanical survey of plants used as repellents against housefly, Musca domestica L. (Diptera: Muscidae) in Budondo Subcounty, Jinja District, Uganda. *Journal of Ethnobiology and Ethnomedicine*:1-8 ,14:35

8.Bandara P. Senevirathne M. (2021). Efficacy of different parts of clove (*Syzygium aromaticum*) for the management of rice weevil (*Sitophilus oryzae* L.).*Proceeding of the Open University Research Sessions (OURS*), 1-5

9.Ben Salah M., Gharbi N. & Khelifi S. (2025). Dose-dependent repellent activity of Laurus nobilis leaf essential oil against adult Ectomyeloisceratoniae Zeller under laboratory conditions. *Journal of Entomology and Zoology Studies*, 13(6): 326-329

10. Bendifallah L., Tabli R., Khelladi H., Hamoudi-Belarbi L., Hamoudi S.(2021). Biological Activity of the *Mentha spicata* L. and *Salvia officinalis* L. (Lamiaceae) Essential Oils on

Sytophilusgranarius L. and *Tribolium confusum* Jac. Du Val. Infested Stored Wheat. *Biol. Life Sci. Forum*, 4 (108): 9p.

11. Boate U.R. &Otayor R.A. (2020). Review on the bio-insecticidal properties of some plant secondary metabolites: Types, formulations, modes of action, advantages and limitations. *Asian J. Res. Zool.*3 : 27–60.

12. Boudemagh, N. E. H., Bouzellat, N., &Boulaiche, R. (2025). Characterization of insecticidal plants used in Setif, Algeria. Indian Journal of Entomology. https://doi.org/10.55446/ije.2025.3293

13. Chelef, M., Hemida, H., Hassani, A., &Mazrou, K. (2020). Efficacy of three vegetal powders against *Sitophilus granarius* in stored wheat and the evaluation of their effect on grain parameters. International Journal of Environmental Studies, 78(4), 679–695. https://doi.org/10.1080/00207233.2020.1845556

14. Chitra S. & Subramanian S. (2016). Storage insect pests and their damage symptoms: an overview. *Journal of Grain Storage Research*, 53-58.

15. Demis E. &YenewaW. (2022). A review on major storage insect pests of cereals and pulses. *Asian Journal of Advances in Research*, 12(1): 41-56.

16. Dossou M., Aikpon R., Todo E., Lokossou A.S., Adjottin B., Obossou E. &Dassou H. (2025).Étudeethnopharmacologique des plantes utilisées contre les moustiques dans les trois zones bioclimatiques du Bénin.*Int. J. Biol. Chem. Sci*. 19(1): 180-195

17. El Baghazaoui R., Belmalha S., Boutagayout A., Nassiri L., El Alami S., Savoie J.M., Bouiamrine E.H. (2024).Insecticidal Properties and Chemical Characterization of *Laurusnobilis*L. Essential Oils from Two Regions of Morocco against *Callosobruchusmaculatus*(Coleoptera: Bruchinae). *Agriculture*, 14, 1150.

18. Elumalai K., Kasinathan I. D. & Saranya J. (2016). Role of plants and plant based products towards the control of insect pests and vectors: A novel review. *Journal of Coastal Life Medicine*; 4(11): 930-946

19. Hamel D., Rozman V. & LiškaA. (2020). Storage of Cereals in Warehouses with or without Pesticides. *Insects*, 11(12), 846. doi:10.3390/insects11120846

20.Ito E.E.&Anigboro O.F., (2019). Evaluation of Repellent Potential of Some Botanical Products against Cowpea Weevil, *Callosobruchus maculatus* (Fabricius) (Coleoptera: Bruchidae). *Jordan Journal of Biological Sciences,*12(3 268):267- 273

21. Karunamoorthi K. & Hailu T.(2014). Insect repellent plants traditional usage practices in the Ethiopian malaria epidemic-prone setting: an ethnobotanical survey. *Journal of Ethnobiology and Ethnomedicine,* 10:22, 1-11

22. Lekhnath K. & Cheng J. S. (2013).Toxicity and Repellency of Compounds From Clove (*Syzygium aromaticum*) to Red Imported Fire Ants *Solenopsis invicta* (Hymenoptera: Formicidae). *Journal of Economic Entomology*, 106(1):131-135.

23.Mahfuz I., Khatun R., Jahan N., Akhter R., Mahdi S.H.A, (2023).Repellent effect of lavender and rosemary essential oil against *Tribolium casteneum*and*Sitophyllusoryzae* .*International Journal of Entomology Research*, 8(1):36-41

24. Mahmoud H. M., Azab M.M., El-Gizawy K. Kh. & Darwish A.A. (2026). Annals of Agricultural Science, *Moshtohor* (ASSJM), 64(1): 1– 8

25.Mc Donald, L.L., Guyr, H., Speire, R.D. (1970). Preliminaryevaluation of new candiolatematerials as toxicants, repellent and attracts against stored product insect. marketing Res. p189

26. Mejdoub K., Benomari F.Z., Djabou N., Dib M.E.A, GaouarBenyelles N., Costa J.&Muselli A. (2019). Antifungal and Insecticidal Activities of Essential Oils of Four *Mentha* Species.*Jundishapur J. Nat. Pharm. Prod*., 14(1):e64165.7p

27. Najem M., Bachiri L., Bouiamrine E.H., Ibijbijen J. & Nassiri L. (2019).*Ruta chalepensis* (L.): Phytochemical study and bioinsecticidal effect against *Tribolium castaneum* (Herbst.). *International Journal of Herbal Medicine*, 7(4): 01-05

28. Najem M., Bammou M., Bachiri L., Bouiamrine E.H., Ibijbijen J., & NassiriL. *Ruta chalepensis* L. (2020). Essential Oil Has a Biological Potential for a Natural Fight against the Pest of Stored Foodstuffs: *Tribolium castaneum*Herbst.*Evidence-Based Complementary and Alternative Medicine* Volume 2020, Article ID 5739786, 11 pages

29.Nazir T., Aslam A., Malik M.K., Akhtar M.F., bin Iqbal M.B., Nadeem I., Zubaird M., Hanif K., Qasim M.U. & Anjum N.A. (2025). Evaluation of Insecticidal and Repellent Potential of Botanicals Against the Red Flour Beetle, *Tribolium castaneum* (Herbst). *International Journal of Research Publication and Reviews*, 6 (12): 768-772

30. Ngegba P.M., Cui G., Khalid M.Z. & Zhong G. (2019). Use of Botanical Pesticides in Agriculture as an Alternative to Synthetic Pesticides. *Agriculture*, 12(600): 1-24

31. Pedros A.L., Schonwald M.K., Dalla Corte C.L., Antunes Soares F.A., Sperança A., Godoi B., Rodrigues de Carvalho N., (2023). Effects of *Rosmarinus officinalis* L. (*Laminaceae*) essential oil on adult and larvae of *Drosophila melanogaster. Toxicology Research*, 12, 913–921

32. Peña-Flores, C., Zapién-Martínez, A., Sánchez-Cruz, G., Reyes-Velasco, L., Segura-Salvador, A., Vargas-Arzola, J., Hernández-Osorio, L. A., Torres-Aguilar, H., & Bernardino-Hernández, H. U. (2025). Insecticidal and repellent activity of plant powders on the weevil (Sitophilus zeamais) in stored corn grains in a rural community of Oaxaca, Mexico. Insects, 16(3), Article 329. https://doi.org/10.3390/insects16030329

33. Suleiman M. & Sani, I. (2017).Repllency potential of three plant powder against *Callosobruchus maculatus* F. [Coleoptera::Chrysomelidae]. *J. Biopesticides and Environment*, 4 (2):9 -15

34. Tamgno B. R. & Ngamo T. S. L. (2013). Diversity of Stored Grain Insect Pests in the Logone Valley, from Northern Cameroon to Western Chad Republic in Central Africa. *Journal of Agricultural Science and Technology*, A 3: 724-731.

35. Tamiru A. & Khan Z.R. (2017). Volatile Semiochemical Mediated Plant Defense in Cereals: A Novel Strategy for Crop Protection. *Agronomy*, 7, 58.

36. Tampe J., Parra L., Huaiquil K. & Quiroz A. (2016). Potential repellent activity of the essential oil of *Ruta chalepensis* (Linnaeus) from Chile against *Aegorhinus superciliosus* (Guérin) (Coleoptera: Curculionidae). *Journal of Soil Science and Plant Nutrition,* 16 (1) : 48-59

37. Yang X., Jin C., Wu Z., Han H., Zhang Z., Yongjian Xie & Zhang D. (2023).Toxicity and Physiological Effects of Nine Lamiaceae Essential Oils and Their Major Compounds on *Reticulitermes dabieshanensis*. *Molecules*, 28, 2007.

38. Yeom H.J., Lee H.R., Lee S.C. , Lee J.E., Seo S.M. , Park I.K. (2018). Insecticidal Activity of Lamiaceae Plant Essential Oils and Their Constituents Against *Blattella germanica* L. Adult. *Journal of Economic Entomology*, 111(2), 653-661

39. Zohra, M. F., Assia, B., Hayet, S., Atika, B., & Koula, D. (2024). Evaluation of the insecticidal activity of Nerium oleander and Artemisia campestris powder and extract on wheat insect pests. *Revista de GestãoSocial eAmbiental*, 18(5). https://doi.org/10.24857/rgsa.v18n5-149